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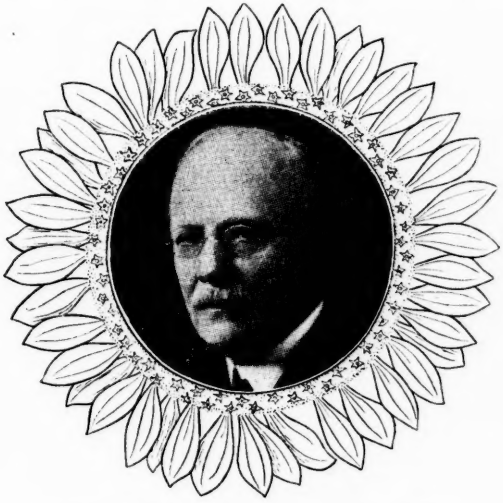

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GRASSHOPPER INJURY TO THE INFLORESCENCE OF PASTURE GRASSES*

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While searching for insects infesting in culms of grasses in the vicinity of Manhattan, Kansas, during the summer of 1932, the writer observed a peculiar and widespread insect injury to the inflorescence of a large series of grasses. This injury was first noticed on such maturing grasses as brome grass and side oats grass but was much more prevalent on later flowering grasses. The evidence, though circumstantial, pointed definitely and conclusively to the grasshoppers as the agents responsible for the injury.

The following general types of injury were readily recognizable and often more than one type could be found on the same grass species:

1. On certain grass species a small portion of tender culm just above the upper node was eaten, severing the florescence.

2. On an number of grasses the leaf sheaths that were wrapped about the developing inflorescence were stripped off on one side and part or all of the inflorescence consumed.

3. While the developing kernels of several grasses were in the milk stage, they were stripped of their protective bracts and consumed.

4. On grasses of the genus **Elymus** many of the spikelets were either pulled off or clipped off before they were mature.

DESCRIPTION AND EXTENT OF INJURY. FIELD OBSERVATIONS.

Agropyron smithii Rybd.—western wheat grass. While the kernels in the heads of this grass were in the milk stage, the protective bracts that surrounded them

*Contribution No. 437, Department of Entomology, Kansas Agricultural Experiment Station.

(1) These observations were made in connection with Project 115 B entitled "Insects Affecting Pasture and Lawn Grasses."

were torn off and the milky kernels consumed. Approximately 50 percent of the heads of **A. smithii** observed in the pastures of the animal husbandry department of Kansas State College had been seriously injured in this way.

Andropogon furcatus Muhl.—big bluestem.

Andropogon scoparius Michx.—little bluestem. As the inflorescence of these two important prairie grasses are very much alike, the grasshopper injury was of the same type. During their development, the flowering parts are protected by wrappings of leaf sheaths and remain moist and succulent. Minute beads of water are frequently present within the leafy covering even though external conditions are excessively hot and dry. Only occasionally do grasshoppers nibble on the leaves of the blue stems but during the 1932 season they climbed the stems, tore holes through the leaf sheaths that enveloped the inflorescence and partially or wholly consumed the tender parts within. Those parts not consumed dried up. As both of the **Andropogons** have a compound inflorescence, the grasshopper injury was repeated at each flowering internode. (Plate 2 Fig. 1)

Because of their compound inflorescence, it was difficult to estimate the full extent of the damage by grasshoppers to the bluestems. Therefore the following grading scale was established and each bluestem culm examined was evaluated accordingly:

DEGREE OF INJURY

0—no injury to inflorescence
1—1% to 20% injury to inflorescence
2—21% to 40% injury to inflorescence
3—41% to 60% injury to inflorescence
4—61% to 80% injury to inflorescence
5—81% to 100% injury to inflorescence

Two thousand culms of **A. scoparius,** all random samples, were examined, 1000 from a hill top and 1000 from the southwestern slope of a hill. Three thousand random culms of **A. furcatus** were examined, 1000 from the prairie hill top, 1000 from the eastern slope and 1000 scattered along the roadside. The extent of the injury to their inflorescence is shown in the following tables:

ANDROPOGON SCOPARIUS (1)

Location	Date 1932	Total Culms Examined	Degree of Injury						Ave. Degree of Injury
			0	1	2	3	4	5	
Top	Sept. 8	1000	11	39	103	186	389	272	3.67
S. W. Slope	Sept. 1	1000	0	1	15	75	366	543	4.44
	Percentage		0.55	2.00	5.90	13.05	37.7	40.7	

ANDROPOGON FURCATUS (1)

Hill top	Sept. 2	1000	39	87	159	240	253	222	3.38
East slope	Sept. 6	1000	235	253	170	166	116	60	2.42
Roadside	Sept. 3	1000	173	188	180	178	148	133	2.83
	Percentage		14.9	17.6	20.3	16.9	17.7	13.8	

(1) These examinations were made by W. R. Smith, assistant on Project 115 B.

Only one-half of one per cent of the culms of **A. scoparius** were entirely free from grasshopper attack upon their inflorescence while 15 percent of **A. furcatus** were uninjured. Of the 2000 culms of **A. scoparius** examined, 1570 fell in classes four and five and thus were from 60 to 100 percent destroyed. Injury was not as

severe in **A. furcatus** but still averaged from 35 to 48 per cent of the inflorescence destroyed.

Bouteloua curtipendula (Michx.) Torr.—side oats grama. Just above the upper node on each culm of side oats grama bearing a head there is a small portion of the culm that remains tender and succulent for some time after the rest of the plant has become dry and unpalatable. This tender portion is well protected by tightly wrapped leaf sheaths. On many of the plants the grasshoppers climbed the stems to the upper node, stripped away part of the protective covering and consumed the tender portion, thus severing the developing head from the plant. The heads, though severed, usually were held upright by the undamaged part of the leaf sheaths. They could be spotted at a distance, however, as they immediately turned yellow and assumed the same blasted appearance as do wheat heads destroyed by the wheat stem maggot. More than 50 per cent of the heads of side oats grama growing in a low prairie pasture were clipped off in the manner described. (Plate I Fig. 2)

On many of the heads of side oats that were not severed, the kernels were attacked. The bracts were torn off and the milky kernels consumed.

Bromus inermis Leyss—Hungarian brome grass. This was one of the few grasses of which the entire head and much of the foliage were completely consumed by the grasshoppers. When the head alone was attacked, the bracts around the kernels were torn off and the milky kernels consumed. In many cases the spikelets were clipped off leaving a skeleton panicle. Brome grass was the most completely destroyed of any of the grasses observed. (Plate I Fig. 1)

Elymus robustus Schribn. and Smith—wild rye. Occasional specimens of this grass were found in which the heads had been attacked and partially consumed while enclosed in the protective covering of leaf sheaths. Usually however the heads were not injured until after they had emerged. The milky kernels were consumed but more characteristically than in any other grass many spikelets were pulled off or cut off from the rachis. This work was done before the kernels were ripe and is not comparable to the natural shattering that normally takes place in the mature heads of **E. robustus.**

Elymus virginicus L.—wild rye. Frequently the heads of **E. virginicus** were attacked before they emerged

from the leaf sheaths. The latter were shredded on one side and the succulent inflorescence consumed. Also the heads were attacked while the kernels were in the milk stage and the kernels consumed. (Plate I Fig. 3)

Spartina michauxiana Hitchc.—slough grass. The heads were attacked immediately after they had emerged from the leaf sheaths and the tender florets were eaten. Normally the spikelets of this grass lie regularly and smoothly along their spike but following a grasshopper attack they are so disorganized as to give the inflorescence a feathery appearance. One hundred percent of the heads of this grass which grew along the roadside by the college pasture showed evidence of grasshopper attack. (Plate II Fig. 2).

Sporobalus asper (Michx.) Kunth. In **S. asper** the elongated inflorescence develops within an enfolding leaf sheath. The kernels are mature before they emerge from their protective covering. Therefore the grasshoppers stripped off the leaf sheath and consumed the milky kernels and other succulent parts of the inflorescence.

Syntherisma sanguinalis (L.)—common crab grass. The grasshoppers tore off the bracts protecting the tender florets and consumed the florets and the developing kernels.

GRASSHOPPERS, THE RESPONSIBLE AGENTS

In spite of their name and their natural habitat grasshoppers of the North American prairies do not appear to be serious pests of the native grasses in which they live. Few accounts of the larger outbreaks report any considerable destruction to the native grasslands. Rather they read much like that of the First Report of the United State Entomological Commission (1887) which states: "Introduced grasses are sometimes killed but wild grasses, though eaten when young, always recover." Milliken (1916) says: "The sparse native grasses are not eaten when other foods can be secured." Severin and Gilbertson (1931) report: "Many of our native grasses are also immune." The list of grasshopper species in any prairie habitat is usually long but the numbers are normally too few to make an impression on a good prairie pasture through the consumption of its foliage.

In 1932 only a normal population of grasshoppers were present in the pastures. They were not sufficiently abundant to injure neighboring crops and the only pas-

ture grass consumed in large quantities was brome grass. The grasshopper species consisted largely of the following although other species were present in limited numbers:

ACRIDIDAE
Orphulella speciosa
Melanoplus bivitattus
Melanoplus mexicanus
Melanoplus differentialis
Melanoplus femur rubrum
Melanoplus packardi
Ageneotettix deorum
Mermiria spp.
Syrbula admirabilis
Dichromorpha viridis
Chortophaga viridifasciata
Hippiscus rugosus
Pardalophora haldemanii
Arphia xanthoptera

TETTIGONIIDAE
Orchelimum vulgare

While the grasshoppers were not observed in the act of feeding on the grass heads there is much evidence to convict them of work. 1. Extensive collecting was carried on throughout the summer season over the grass areas studied and no other insects were taken that would be likely to cause a similar type of injury. 2. During the period when the injury occurred, the daily temperatures were sufficiently high to cause the grasshoppers to move up the stem of grasses and shrubs to escape the heat. 3. Grasshoppers are especially sensitive to a lack of moisture and will perform many strange acts in response to the moisture requirement. 4. Grasshoppers have also been known to cause somewhat similar damage to the heads of grain.

During periods of excessive heat and drought grasshoppers will climb up the stems of grasses in order to escape the heat. They were observed in this position many times during the 1932 season. Parker (1930), studying the problem of "climbing to escape heat" in Montana, found that when the air temperature at 4 feet above the ground was 90 degrees F. the temperature at the surface of the ground was 134.6 degrees F. and the temperature at 2 inches above the ground was 96.8 degrees F. Therefore if a grasshopper on the ground climbs a grass stem to a height of 2 inches above the ground, it reaches a position 39.8 degrees F. cooler than its previous position.

During the 1932 season there were two distinct periods of excessive heat. June was a month of well distributed rainfall, slightly above normal, and of moderate temperatures. These formed ideal growing conditions and the grasses were afforded an excellent start. July, however, was hot and dry. The total rainfall was 1.91 in., or over 2.5 in. below normal. Twenty five of its days

had maximum temperatures of 90 degrees F. or more and 11 days had maximum temperatures of 100 degrees F. or more. In the fore part of August a series of light rains invigorated the grasses only to be followed by 18 days between August 13 and August 31 with only .32 in. and 14 days with temperatures of 90 degrees F. or more. A similar 18 day dry period occurred in the fore part of September. Such temperature and rainfall conditions were ideal for the promotion of the "climbing to escape heat" habit.

It is well known that grasshoppers are especially sensitive to moisture requirements. The experiments of Bodine (1921) have demonstrated that grasshoppers will live nearly twice as long without food but with water as without both food and water. Uvarov (1928) from his own observations and from those of Nikolsky recorded striking illustrations of unusual reactions of grasshoppers in answer to their water requirements. These included the consumption of damp clothes hung on a line to dry while that part of the washing already dry remained intact; the devouring of the crushed bodies of their own species; and the settling on trees and the biting off of the stalks of leaves so that the latter dropped but were not eaten.

On occasions the heads of cereal grains have been attacked by grasshoppers with serious results. Dean and Kelly (1920) reported such an incident which occurred in Kansas in 1919. "The hot days in late June following a wet period ripened the wheat very rapidly. The hoppers had eaten most of the leaves and those left dried quickly in the sun. The grasshoppers in search of food simply crawled up the stalks where they found a bit of green just below the head. Here they ate an elongated notch into the stem. Right at this time there came an unusually hot Saturday, followed by a brisk wind on Sunday, and when the sun set on that memorable day, June 29, Kansas had lost millions of bushels of wheat which was literally strewn on the ground." In this instance the grasshoppers were not sufficiently abundant to have destroyed the wheat had it not been for the hot, dry winds.

Several other writers (Felt 1915) (Shotwell 1930) (Herrick and Hadley 1916) have mentioned grasshopper attacks upon the milky kernels of wheat, rye, barley and oats and the clipping of oat kernels. Corkins (1932) summarized the situation: "Especially during a dry season when succulent food is scarce, severe damage may

be done by a limited number of 'hoppers upon the heads of grain. Kernels of wheat and barley may be eaten out, or even the heads cut off completely. Oat kernels are often clipped off one by one and dropped untouched to the ground." This type of injury is very similar to that herein described on the inflorescence of grasses.

DISCUSSION

It has been shown that under proper conditions of temperature and moisture relatively few grasshoppers may cause great damage to grain crops by clipping the heads or eating the developing kernels. The destruction of the 1919 wheat crop in several counties in Kansas when the growers considered the grasshoppers too few to trouble about baiting is a good example of this. Similarly, a few grasshoppers can destroy the pasture grass seed crop, given favorable conditions. Native prairie grasses are generally considered poor seed producers, particularly in dry years. From the experience of 1932 at Manhattan, Kansas, it is possible that part of the seed failure in dry years is due to grasshoppers. Certain types of the injury previously described on the inflorescence of the grasses would easily pass for drought injury after the inflorescence had pushed up out of the protective leaf sheaths.

Careful search for injury by grasshoppers to the inflorescence of grasses was made throughout the 1933 season but only a few specimens were found. May and June of 1933 were short of rainfall and grasses were very slow in starting. July, August and September had rainfalls slightly above average. However, in the 33 day period between July 18 and August 20 there was a total rainfall of only 0.37 inches. It was during this period that the few specimens of damaged grass heads were found. Most of the grasses did not head until later due to their late start. After August 20 the rains were sufficiently timely and abundant to provide moisture at all times and the grasses flowered luxuriantly. During the 1934 season, the drought and high temperatures made the flowering of grasses nearly impossible until after the fall rains started when there was ample moisture for both grasses and grasshoppers.

Uvarov (1928 p. 72) strongly suggests that nibbling on plants is due to insects seeking water, not food. He says that there is only one chemical combination towards which Acrididae nearly always exhibit a positive chemo-

tropism, this being water. All of the data brought forth in this paper concerning the attack of grasshoppers upon the inflorescence of grasses support this suggestion. The parts of the inflorescence that were still growing, as the culm above the upper node in side oats grama and the undeveloped flowering parts in the bluestems, were probably exceptionally rich in nitrogenous compounds and in sugars, because this is true in the corresponding parts in wheat (Eckerson 1917). However if the inflorescence were attacked for their richer feeding value, these same parts would probably be utilized by the hoppers year in and year out, wet or dry, at the time of flowering or heading of the grasses. This condition did not occur. Therefore on the evidence available one must conclude that the attack of grasshoppers upon the inflorescence of grasses is an adaptation for satisfying the moisture requirements during exceptionally dry periods.

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EXPLANATION OF PLATES

Plate I

Fig. 1. **Bromus inermis,** showing attack upon kernels.

Fig. 2. **Bouteloua curtipendula,** showing stripping of leaf sheath and consumption of culm just above the highest node.

Fig. 3. **Elymus virginicus,** showing heads from which the kernels have been pulled off.

Plate II

Fig. 1. **Andropogon furcatus,** showing stripping of protective leaf sheaths from the developing flowers. The injury is repeated at each flowering internode.

Fig. 2. **Spartina michauxiana,** showing feathery appearance of inflorescence following a grasshopper attack.

PLATE I.

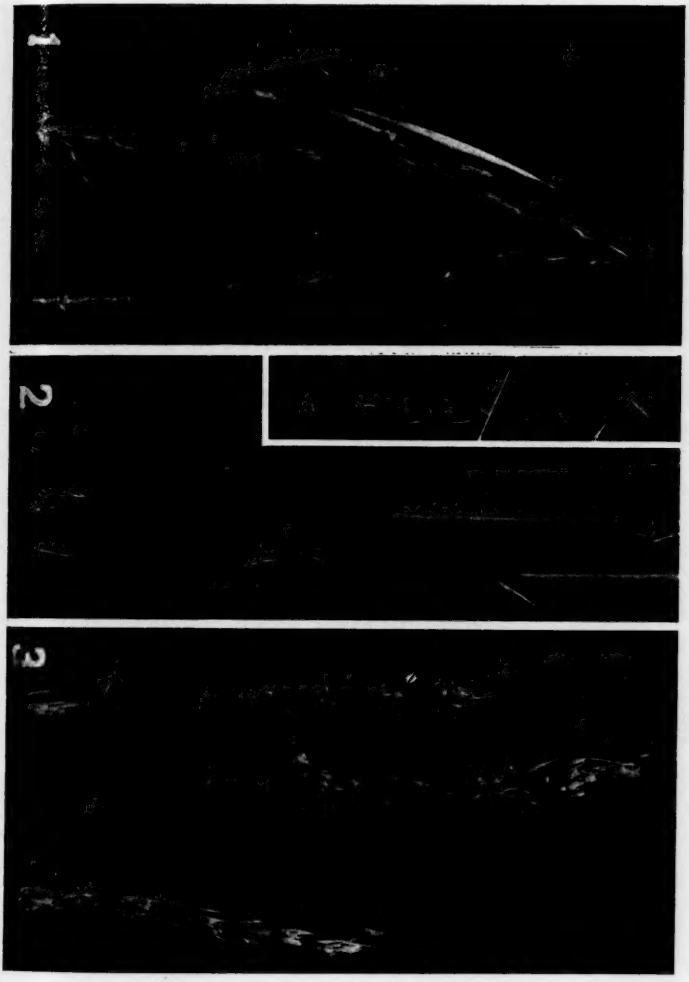
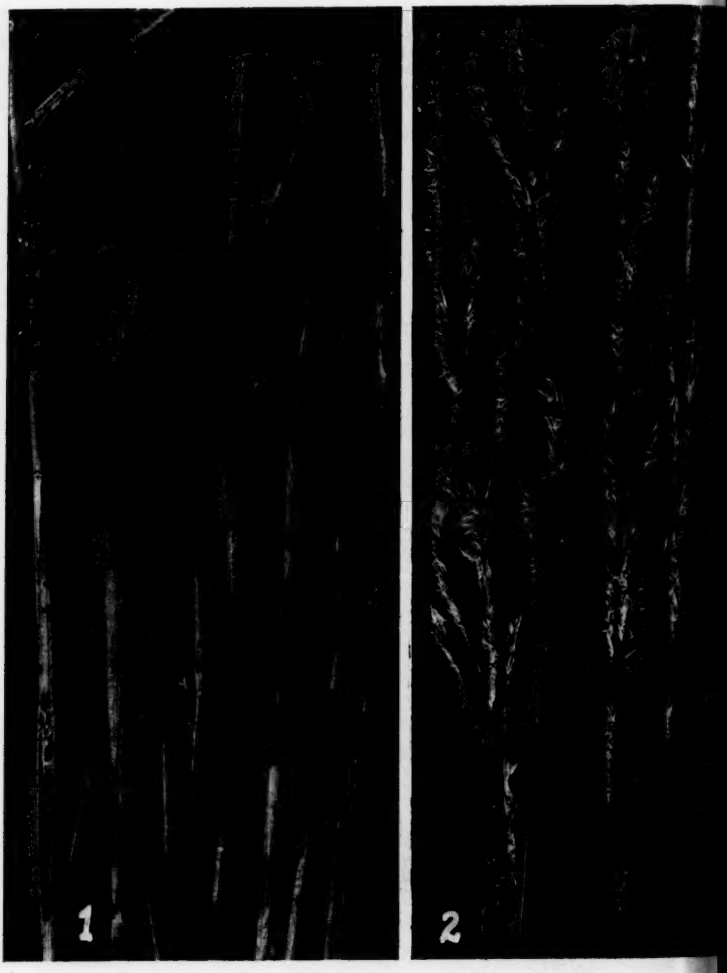


PLATE II.



NOTES ON BIOLOGIES OF NUT INFESTING WEEVILS[1]

OTTO KUMPE and DWIGHT ISELY
University of Arkansas

Nut weevils have been given most attention as pests of nuts which are used for food, particularly the chestnut and the pecan. They are also of importance, at least in acorns, as they affect the viability of seed and thus may affect reforestation. In Arkansas a combination of species destroys from 50 to 90 per cent of the acorn crop.

The earlier studies of nut weevils associated the nut infesting species with their hosts, and reported observations on habits and life historys (1, 4). The only species of Curculio (Balininus) for which the life cycle is reported in detail are **C. proboscideus** (Fab.), **C. auriger** Casey (3), and **C. caryae** Horn (7). Brooks also made life history studies of four species of Conotrachelus attacking walnuts and hickories (2). The genus Curculio in North America has recently been revised by Chittenden (5).

A cursory study of nut weevils in northwestern Arkansas was made from 1930 to 1933 to determine the species occurring in the state, to determine their relative importance, and to associate these species as far as possible with their hosts. Six species[2] of Curculio were reared,—four from acorns, one from chinquipin and one from hickory. In addition a species of Conotrachelus was found associated with the species of Curculio attacking acorns. A species of Conotrachelus was also reared from hickory nuts and another from walnuts, but both of these were summer pests causing an early drop but did not occur in the nuts at harvest, and consequently are not associated with weevils of the genus Curculio.

All rearing records were based on specimens secured from nuts collected in Washington County Arkansas, and reared in the insectary of the Department of Entomology at Fayetteville. After leaving the nuts the larvae were placed on soil in flower pots, in which they formed their pupal cells. During winter the pots were buried under shelter of the insectary where moisture conditions and temperature were practically normal except that they were protected from beating rains. During the sum-

1. Research Paper 378, Journal Series, University of Arkansas.

2. The writers are indebted to Doctor L. L. Buchanan of the U. S. Bureau of Entomology for determination of species.

mer the pots were covered with lantern chimneys so that the emerging adults could be readily observed.

Four species of the genus Curculio were reared from acorns. These species are **C. pardalis,** Chittn., **C. baculi.**, Chittn., and undetermined species near **C. parvidens**, Chittn., and **C. rectus,** Say. These species all appear to have similar life cycles and were not definitely associated with a single species of oak. All of them pass winter in the larval stage and all have either a one-year or two-year life cycle. The two-year life cycle seemed most usual for all the species except **C. rectus.** Those individuals which spend two years in the soil transform to the adult state late in the fall before the second winter.

Curculio pardalis appears to be the most abundant species of this genus attacking acorns in northwestern Arkansas. About 75 per cent of specimens reared required two years for development. Most of them emerged from the soil during the month of September, although extreme records of emergence range from July 6 to October 4. It has been reared from the following hosts —**Quercus alba, Q. velutina, Q. stellata, and Q. muhlenbergii.**

From limited rearing records it appears that **C. baculi** requires two years for its immature development. A larger series might show more variation. It has been reared from a single host, **Quercus velutina.** This species is common in the Arkansas collection and collection dates range from August 8 to September 28.

The species near **C. parvidens** may have either a one year or two year life cycle, although the majority reared required two years. This species has been reared from **Quercus alba** and **Q. velutina.** The period of emergence ranged from July 26 to September 12.

C. rectus alone among the species attacking acorns appears to have a tendency toward a one-year life cycle. Eighty per cent of the specimens reared emerged from the soil during the first year. It has been reared from **Q. alba** and **Q. velutina.** The period of emergence ranged from July 7 to September 23. Specimens of this species are more numerous in the University of Arkansas collection than those of any other member of the genus.

Conotrachelus naso Lec. is distinctly the most important weevil attacking acorns in Arkansas. More specimens of this species were reared than from all four of the Curculios attacking acorns. It has been reared

from **Q. alba, Q. stellata,** and **Q. velutina.** As with Curculio, the larvae were found at the end of the season. The larvae left the acorns and entered the soil from October 1 to December 19. In all cases the adults emerged the succeeding summer. The period of emergence was from May 4 to July 20. The adults are active on oaks during the summer and begin ovipositing soon after the acorns begin to form.

A single species was reared from chinquipins, **C. auriger.** As reported by Brooks and Cotton (3) this species has a definite two-year life cycle. Upon leaving the nuts in the fall it buries itself in the soil where it passes the first winter as a larva and the second winter as an adult. It emerges the following May and June. Adults were frequently collected on catkins in early June. A complete life history is given by Brooks and Cotton.

Curculio caryae is economically the most important species of this genus in the South on account of the increasing importance of the pecan crop. The life cycle may require as long as three years. All specimens reared passed two winters as larvae and the third in the adult stage. However, the series reared was too small to cover all variations. The fact that the species may require three years to complete its life cycle and pass winter before emerging has been recorded previously by Gill (6). All records were secured from larvae reared from **Hicoria alba.** It is also recorded by other investigators from **H. pecan, H. ovata, H. minima,** and **H. alba.** The species is most frequently collected in the field during the month of September.

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OBSERVATIONS ON SUNFLOWER INSECTS IN KANSAS(1)

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This paper records a list of insects found in Kansas on both wild and cultivated sunflowers (**Helianthus** spp.) by the writer, with some observations on those causing the greatest amount of damage.

The majority of the collections and observations were made upon **Helianthus annuus** L. in the vicinity of an alfalfa field at Manhattan, Kansas. Plants were grown close together in rows, and plantings were made at intervals during the season so as to allow observations on all stages of the plant growth throughout the summer and fall. Some observations were made upon wild sunflower plants, of which there are several species in Kansas. The work extended throughout the summer and fall months of 1931 and 1932, there being but few observations made on the overwintering stages.

A review of the literature on sunflower insects revealed chiefly only fragmentary notes on the habits, life history, host records and damage done by particular insects. In the "Report of the Entomologist", U. S. D. A. 1920-'21, L. O. Howard stated that the work had been started on sunflower insects in the middle west on account of the value of the plant as an ensilage crop, but the writer has been unable to find any published results of this work. There has been no recorded observations of work done on insects attacking sunflowers in Kansas, where the plants grow abundantly and have many insect pests. Probably the greatest amount of work on sun-

(1) The author is indebted to Dr. R. C. Smith and others of the Department of Entomology of Kansas State College for advice and encouragement, and to the following who determined many of the specimens recorded: R. A. Cushman, C. J. Drake, E. P. Felt, W. T. M. Forbes, C. A. Frost, B. B. Fulton, H. H. Knight, C. W. Johnson, D. Moulton, C. F. Muesebeck, Miriam Palmer, R. H. Painter, H. J. Reinhart, Grace Sandhouse and D. A. Wilbur.

flower insects in the United States has been done by T. D. A. Cockrell in Colorado. In Russia, considerable work has been done on sunflower insects on account of the economic importance of the plant for the production of both oil and seed.

The following is a list of insects reared and collected during these studies. The list is arranged according to the part of the plant attacked and placed in the order of the amount of damage done:

LEAF FEEDERS

Charidryas nycteis Doubl. and Hewitt.: The larva of this nymphalid was the most common insect found on the sunflower leaves in the early part of the season. The first generation appeared during the latter part of May or early June. The insect overwintered as a chrysalid in sheltered places. The egg stage averaged about 9 days. There were two species of parasites reared from the larva of **C. nycteis.** A hymenopterous parasite **Apanteles hyphantantriae** Riley, was found attacking larvae of the 3rd and 4th instars. The second and third generation were about 70 percent parasitized resulting in the rapid decrease in the number of insects present later in the season. A dipterous parasite, **Phorocera claripennis** Mac., also was reared from the larvae. Predators attacking the young larvae were Vespids and several species of Pentatomidae. The latter were the more common and attacked larva of the 2nd, 3rd and 4th instars.

Calligrapha exclamationis Fab. (Sunflower leaf beetle): The adults and larvae were found on isolated plants in the vicinity of Manhattan, causing considerable damage to the young foliage. There were two generations a year, the second generation overwintering as pupae in the ground.

The eggs of the first generation were laid from June 20 to July 15, and were deposited on both surfaces of the leaves or on the stem, and were confined to the terminal region of the plant. The eggs were void of covering, elliptical in shape, whitish-yellow in color, and measured 2-3 mm. in length. They hatched in from 4 to 5 days after deposition. Newly hatched larvae were 1-3.5 mm. long while mature larvae were 8-12 mm. long. The larvae were light green in color, the dorsal surface having narrow transverse light yellow stripes on the anal margin of each body segment to the lateral margin; ventral surface dark yellow; head capsule light brown. The anal end of

the larva had a flat disc-like protrusion which adhered to surfaces and assisted the insect in locomotion.

The young larvae fed upon the tender unfolding leaves in the terminal bud and, as they increased in size, were found feeding upon the more mature leaves or in the leaf axis. They curled up like balls while feeding and were difficult to see as they are much the same color as the plant, concealing themselves in the leaf axis or in the leaf folds of the terminal regions. They remain in the larval stage about 16 days.

Mature larvae fall to the ground July 13 to 16 and pupate within earthen cells at a depth of 1 to 3 inches. They remain in these cells for about 17 days, emerging in the middle of August. Soon after emerging the adults start feeding, mating and laying eggs for the second generation.

Chrysopid larvae were found feeding on the younger larvae of this species.

Aphis helianthi Mon'l.: This insect was abundant on the lower surface of the leaves from early June to middle July; after this period it became scarce. There were also a few mealy bugs and white flies present at this time, but these insects disappeared with the aphids.

A hymenopterous parasite, **Lysiphlebus testaceipes** Cress., was reared from the aphids but they were never present in large numbers.

A common predator was a coccinellid larva, **Hippodamia convergens.** Many chrysopid larvae and several specimens of **Mantispa brunnea** Say were taken among colonies of these aphids.

Gryllidae: Two species of tree crickets were found upon the foliage of sunflower. One species, **Oecanthus nigricornis argenitinus** Saus., was common, both the nymphs and adults being taken; of the other, **Oecanthus niveus** DeGeer, only adults were taken.

Bucculatrix sp.: Several larvae were found on the foliage.

Unidentified geometrid larvae: These larvae were found feeding on the sunflower in the late spring. The mature larva was about 13 mm. in length, yellow-brown, with a light yellow stripe running mid-dorsally; the sides have yellow longitudinal broken lines, giving the larva a speckled appearance. The head capsule and first segment of the larva had several longitudinal stripes alternat-

ing dark brown and white which were considerably wider than those on the rest of the larva.

Corythucha marmorata (Uhler): The adults were feeding on the sunflower leaves in groups of 2 to 5.

Grasshoppers: There were three species found feeding upon the sunflower during the outbreak of 1932; they caused considerable damage. The most common species was **Melanoplus differentialis** Thom. **Melanoplus femurrubrum** Say, and **Melanoplus bivittatus** Say, were also present in large numbers.

Lycophotia margaritosa saucia Hubner, (variegated cutworm): These cutworms were found feeding on the foliage during the outbreak of 1931. There were on the average of from 7 to 12 larvae found in the soil at the base of each plant.

Diacrisia virginica Fab.: A few larvae were reared from the foliage and a dipterous parasite, **Zenillia rectinata** Ald. and Webb., was reared from the larvae.

Estigmene acraea Dru. (Salt marsh caterpillar): Caterpillars of this species were found in moderate numbers upon the foliage.

Cicadellidae: There were four species collected during the month of June. **Cicadula hieroglyphica** Say was common, both nymphs and adults were observed feeding; of the other three species **Eutettix semindus** Say, **Agallia sanguinolenta** Prov., and **Cicadula divisa** Uhl. only adults were found feeding.

Micrutalis calva Say: Adults were abundant on the foliage.

Publilia thanalopana Kirk. was found feeding on the foliage in moderate numbers during September. The records in the Kansas State College collection show that it has been taken only on sunflower in a restricted locality in the vicinity of Manhattan.

Agromyza platyptera Thom.: This blotch miner was present on the foliage early in the summer, but decreased in numbers as the season advanced. The damage by this insect was confined to the lower leaves of the plant.

Two species of hymenopterous parasites were reared from the larva, **Sphegigasterinae** sp. and **Pleurotropis lithocollelidis** Ashm., the latter being the more common.

Zonitis bilineata Say fed upon the foliage in the early part of August, records show that it is a common pest of

sunflower in Kansas.

Chlamydatus associatus Uhl. was found feeding in late July and early August.

Ilnacora stalii Reut.: The nymphs of this species were found feeding in the blooms and the adults fed upon leaves at the terminal region. Both forms disappeared in the latter part of June.

Microrhopala cyanea Say was found upon the foliage in late July and early August.

Baris interstitialis Say was taken on foliage in late July.

Mordellistena sp.: Adults of this genus were abundant on the foliage in late July.

Other Leaf Feeders of Minor Importance.

Vanessa atalanta L. (Red admiral butterfly)

Apantesis arge Dru.

Loxostege similalis Gn. (Garden webworm)

Prodenia ornithogalli Gn. (Cotton cutworm)

Rhinoncus pyrrhopus Boh.

Ogdoconta cinereola Gn.

Loxostege dasconalis Wlk.

Lygus pratensis L. (Tarnished plant bug)

Blissus leucopterus Say (Chinch bug)

Orius insidiosus Say (Insidious plant bug)

Diabrotica duodecimpunctata Fab. (Southern corn rootworm)

Diabrotica longicornis Say (Western corn rootworm)

Acanthocephala femorata Fab.

STEM FEEDERS

Rhynchites aeneus Boh.: This curculionid caused considerable damage to sunflower in late summer and early fall. The adults punctured the stems 8 to 10 inches below the flower. As a result, the stem broke over and the bloom was killed before the seed was set. The adults were found as soon as the plant started blooming late in June to early July, and remained until the latter part of September. The surrounding tissue in the area of the wound was examined for eggs, but none were found; therefore, it was assumed that the insect attacked this region for food only.

Mordellistena pustulata Melsh. (Sunflower pith beetle): Larva were present in large numbers, and most

of the plants were infested with this species.

Rhodobaenus tredecimpunctatus Ill. (Cocklebur billbug): Many of the plants were attacked by this insect, but there were seldom more than one larva to each stem. They were found at soil line during late September.

Papaipema nebris Gn. (Common stalk-borer): Several larvae of this species were found in the stems.

Cerambycidae sp.: Several larvae were collected in the stems.

ROOT FEEDERS

Straussia longipennis Wied. (Sunflower maggot): Maggots of this species which were collected from the roots in moderate numbers during March and emerged in the laboratory about the middle of April.

Elateridae sp.: One larva found feeding on the roots.

FLOWER FEEDERS

Dasyneura sp.: This cecidomyid deposited its eggs in the bloom while the ray flowers were green and undeveloped. The female placed the eggs in the folds of the petals in masses of from 7 to 9, there being from 50 to 200 egg masses in each bloom. The feeding of the larvae at the base of the petals resulted in a reduction of the number of seeds produced.

There were three parasites reared from this Dasyneura; one an egg parasite, **Platygaster** sp. which was very abundant, the other two were larval parasites; **Rileya cecidomyiae** Ash. and **Callimome coloradensis** Huber., only a few of the latter being found.

Diabrotica longicornis Say (Western corn rootworm): Adults were often found feeding upon the blooms. In one case, 24 were found feeding on one flower, and had destroyed over one-half of the rays.

Heterothrips auranticornis Watson were found in abundance within the flowers.

SEED FEEDERS

Tephritis finalis Lw.: Maggots of this species were found in moderate numbers in the seed of the sunflower from the middle of July to early September. The larva eat a single seed, leaving just the shell in which they pupate.

The following two lepidopterous larvae were reared from the heads of sunflower, both being present in large

numbers; **Homoeosoma ellectum** Hulst., which was probably the more destructive species, and **Suleima helianthana** Riley, which was in large numbers. The larva of the latter bored through the seed, leaving a web passage and destroying many seeds. The external burrows make them easy prey for the Vespid wasps which attack them.

Eucosma scintillana Clem.: Several adults were reared from the heads but the writer was unable to determine the nature of their damage. According to W. T. M. Forbes they are gall makers; therefore, they probably emerged from parts of the stems below the heads.

ADDITIONAL INSECTS WHICH VISIT THE BLOOMS

Agapostemon virescens Fabr.
Phthiria sulphurea Lw.
Systoechus vulgaris Lw.
Sparnopolius fulvus Wied.
Melissodes obliqua Say.
Coelixys octodentata Say.
Tiphia robertsoni Mall.

INSECTS SWEPT FROM THE FOLIAGE

Acmaeodera pulchella Hbst.
Dectes spinosus Say.
Hyperaspis undulata Say.
Campylenchia latipes Say.
Fidia citicida Walsh.

SUMMARY

The sunflower proved to have a large number of insect enemies, many of which make this plant the secondary or alternate host. One group, including such insects as the variegated cutworm, chinch bug, triphleps plant bug and grasshoppers which are found on the plant during certain parts of the season or years when there are great numbers present. This was shown by the damage done during irregular outbreaks of variegated cutworms and grasshoppers. The sunflower also has many insect pests which cause considerable damage and are present each year in varying numbers. This group includes such insects as **A. helianthi,** and **C. nycteis** on the foliage, **R. aeneus, M. pustulata** and **R. 13 punctatus** in the stem, **S. longipennis** on the roots, and **T. finalis, H. ellectum** and **S. helianthana** in the seeds.

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TWO NEW SPECIES OF COSMOBARIS (CURCULIONIDAE, COLEOP.)

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The monobasic genus **Cosmobaris** Casey (Mem. Coleop. Vol. 9, p. 344, 1920) of the tribe Barini was erected to include the species of Leng's check list cited as **Baris scolopacea** Germ. a supposedly introduced species from Europe occurring in Rhode Island and Pennsylvania which he named **C. americana** stating that "the European **Baris scolopacea** Germ. comes closer to this species than any other, but it is narrower and more cylindrical, with the pronotum squamose throughout, though unevenly, and the propleura are not denuded; the scales of the elytra are more uniformly oval and dense, though similarly aggregated in white spots among the pale brown scales of the general surface. I formerly held **americana** to be the same as **scolopacea,** but more careful observations with ampler material, show they are different."

The genus is characterized by Casey with having the beak, mandibles and legs nearly as in **Baris,** "but the body is squamose and the beak separated from the head by a deep transverse sulcus. The antennae are slender, with very moderate oval club, the first joint of which constitutes more than half the mass and is loosely pubescent; the basal funicular joint is as long as the next three. The prosternum is flat, feebly fossulate transversely at apex and it separates the coxae by about half their width. The prothorax is feebly constricted at apex."

Among the collections of the Illinois State Natural History Survey, Iowa Wesleyan College and the writer, are a number of specimens of **Cosmobaris** from Illinois and Iowa of which some have borne the label of **Baris scolopacea** Germ., which do not compare with the eastern **C. americana.** Five specimens are in the Survey collection from Pennsylvania bearing the label **Baris scolopacea.** Four of these are Casey's **C. americana** and the fifth is similar to the Illinois and Iowa specimens. The Illinois, Iowa, and one Pennsylvania specimens are new and described below under name **C. squamiger.** A single specimen in the Survey collection from Starved Rock, Illinois, an one from Iowa differ from either of the above, particularly in vestiture, and are described below as **C.**

(1) Contribution from the Entomological Laboratories of the University of Illinois, No. 166.

sionilli.

Cosmobaris squamiger n. sp.

Elongate-oval, slightly convex, dark brown to black antennae and tarsi reddish brown. Irregularly covered with white and pale brown or yellow scales. Those of the pronotum and propleurae arranged transversely. Pronotum with a median denuded area near the base which bears a few scattered, darker and narrower scales. Elytra bear a mixture of large, white scales and narrower, yellowish scales. The white scales are condensed to form an indistinct, white, transverse band behind the middle, also along the basal half of the suture and at base of third interval. Yellow scales of elytra more linear and yellowish to pale brown. Scales of propleurae dense, transverse, and mixed with broad white and narrow yellowish scales. No denuded propleural spot. Mesosternum and abdominal sterna similarly, but not transversely scaled. Those of metaepisterna more condensed and mostly white. Femora and tibiae densely scaled.

Beak strongly arcuate, as long as the prothorax, in female; male shorter; rather coarsely and densely punctured, carinate at basal two-thirds. Sparsely covered baso-laterally with narrow, white scale-like setae. **Antennae** inserted slightly distad of the middle, funicle and club setose more densely and finely on club. Funicle seven-segmented, first segment of funicle as long as the next three.

Head without scales, shining, finely, but somewhat densely punctate. Prothorax slightly longer than wide, sides gradually narrowed toward the head, to form a subtubulate apex, densely punctured, on the sides; each puncture bears a transverse or diagonally placed broad, white or yellow scale; denuded area of the disk bears scattered fine, setaceous scales, punctures of disk separated from each other by a distance less than their diameters.

Elytra mottled with pale brown and white scales as described above. Scutellum small, denuded and shining; striae finely, indistinctly and remotely punctured, intervals much wider than striae, the first with a single row of scales except near the base where the overlapping white scales produce a two-rowed effect, second with a double row and third with three rows in the white scaled area behind the center, others indefinitely with two rows

of scales. **Pygidium** with narrow, suberect, pale brown scales. **Femora** and **tibiae** black, tarsi dark brown. Length 3.25-3.75 mm., width 2.0-2.25 mm.

Holotype—male; Hardin, Ill. June 5-9. 1932. Coll. Dozier. Deposited in Ill. State Nat. Hist. Survey Collection.

Allotype—female; Elizabethtown, Ill. June 25, 1932, Coll. Ross, Dozier and Park. Deposited in Illinois State Nat. Hist. Survey Collection, Urbana, Ill.

Paratypes—Arcola, Ill., July 5, 1931—2♂, Ross; Hardin, Ill., June 5-9, 1932, 1♂ and 2♀, Dozier: E. Dubuque, Ill., June 14, 1932, 1♀, Frison and Mohr; Urbana, Ill., Reared Lambs Quarter, May 1-29, 2♂ and 3♀, Mohr; Beardstown, Ill., June 10, 1932, 1♂, Ross and Mohr; Oquawka, Ill., June 13, 1932, 1♀, Dozier; Havana, Ill., May 31, 1933, 1♂, Mohr: Quincy, Ill.: June 9, 1932, 1♀, Ross and Mohr: Keithsburg, Ill., June 15, 1932, 1♂, Dozier; Alton, Ill., July 19-21, 1932, 1♀; Ross and Dozier; 1—Phila Neck, Pa., 1♀, Stromberg Coll.; Clayton County, Iowa, June 15, 1932, 1♀, Barker; Woodbury County, Iowa, June 30, 1932, 1♀, Moore; Bulter County, Iowa, July 12, 1933, 1♀, H. E. Jaques. Deposited in Ill. Nat. History Survey Collection, Iowa Wesleyan College and in the writer's collection.

This species differs from **C. americana** in being somewhat smaller, in having the beak more strongly arcuate, thorax not wider than long, and in having the scales of the propleurae more dense and unmixed with narrow scales. The propleural scales of **americana** are somewhat denuded and consist of pale, narrow scales while the Illinois and Iowa species have broader white scales that are intermixed with pale brown.

Cosmobaris sionilli n. sp.

Elongate, oval, black, slightly convex; antennae and tarsi reddish brown. Irregularly covered with pale, white scales a few of which are somewhat darker on the sides of the pronotum and which are arranged transversely. The denuded area of the disk bears numerous fine, white setae in the punctures. Scales of the wings arranged as in **C. squamiger** except that all are white without pale, brown scales. The intermixed setaceous scales are a duskier white than the larger scales.

Beak as long as the prothorax, moderately arcuate, faintly carinate above, closely and rather strongly punctate, sides at base with a few white, recumbent setae.

Antennae inserted slightly beyond the middle, reddish brown in color; scape not quite reaching the front margin of the eye, seven-segmented, the first segment twice as long as the second; funicular segment with long, course white setae, the club densely but more finely setose. **Head** glabrous and very minutely and closely punctured. **Prothorax** convex, slightly longer than wide, sides gradually narrowed toward the head to form a subtubulate apex; densely punctured, on the sides each puncture bears a transverse or diagonally placed broad, dingy white scale; some punctures of the denuded disk bear scattered, fine, setaceous, white scales; punctures of the disk separated from each other by a distance less than their diameters.

Elytra scaled as in squamiger but all scales are white. **Pygidium** with narrow, suberect, pale, white scales. Femora and tibiae black. Tarsi reddish brown. Length, 3.5 mm., width 1.6 mm. **Holotype**—1 male. Collected at Starved Rock, Ill., July 14, 1932 by Dozier and Park. Deposited in Ill. State Nat. Hist. Survey Collection, Urbana, Ill. 1 ♂ **Paratype** in writer's collection. Collected in Iowa, July 26, 1932 by H. E. Jaques.

This species differs from **americana** in lacking the denuded area of the propleura, in having the scales entirely white and by the more convex disk of the pronotum.

These species may be differentiated from **C. americana** by the following key.

Key to Species of **Cosmobaris**

1. White scales of elytra not mixed with broad, pale brown scales, narrow scales pale brown or white. Scales of metaepisterna entirely white. Scales of ventral abdominal segments white ..... 2.

1—White scales of elytra mixed with broad, pale, brown scales, narrow scales pale brown, white scales of metaepisterna mixed with pale brown. Scales of ventral abdominal segments mixed with pale brown ..... **squamiger** n. sp.

2. Propleura partially denuded. Narrow scales of elytra pale brown. Scales of pygidium yellow. Antennae dark brown ..... **americana** Casey.

2—Propleura not denuded, narrow scales of elytra white. Scales of pygidium white. Antennae reddish brown ..... **sionilli** n. sp.

NOTES

A FLEA BEETLE NEW TO NEBRASKA

On June 20, 1934, the writer collected **Haltica litigata** Fall in a light trap, at Lincoln, Nebraska. Leng's Catalogue lists it only from Florida but Fall, in Psyche, Vol. 27, 1920, page 105, gives North Carolina, Maryland, Indiana and St. Louis, Missouri as its distribution. In a letter under date of February 24, 1935, he adds Texas and Ohio to the list. (The beetle was identified by C. A. Frost).

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Lincoln, Nebraska.

PHYLLOPHAGA SPRETA (HORN) IN MISSOURI

To collect Phyllophaga in the earlier part of the spring, it has been found profitable to search under dead leaves, and in the first inch or so of top soil beneath trees situated in groves. A collecting trip of this sort, on April 27, 1935, about five miles east of Platte City, Mo., produced several species of Phyllophaga, one of which is of special interest. This was a single male of **Phyllophaga spreta** (Horn). This species was at first thought to be **Phyllophaga inversa** (Horn) upon examination of the genital armature. They approach each other somewhat in this structure, but are readily separated externally, **spreta** (Horn) having the antennal club about one-third longer than the stem. In my specimen the body is also longer and narrower than in **inversa** (Horn). To my knowledge, this is the third specimen of the species to be recorded. The species was described from two males, the localities being given as Maryland and Iowa. For its capture in Missouri, we are indebted to Mr. Lyman S. Henderson, Department of Entomology, University of Kansas.

Other species taken were **Phyllophaga tristis** (Fab.), **marginalis** (Lec.), **fusca** (Froel.), **balia** (Say), and **hornii** (Smith). Several specimens of Serica and Diplotaxis (Scarabaeidae) were also taken in the same habitat.

MILTON W. SANDERSON.

TWO NEW SPECIES OF WESTERN LEAFHOPPERS (HOMOPTERA, CICADELLIDAE)

R. H. BEAMER, Lawrence, Kans.*

Paracoelidia teretis n. sp.

Resembling **Paracoelidia tuberculata** Baker but decidedly smaller and more slender, apex and margins of vertex sharper and ovipositor less exserted. Length male 5 mm.; female 5.5 mm.

General color semihyaline to yellowish in female. In male more nearly golden yellow. Elytra slightly fumose along inner margins but so nearly hyaline as to show dark dorsum of abdomen. Veins of hind wings dark, plainly visible through elytra.

Head narrower than pronotum. Vertex more sharply pointed than in **P. tuberculata** Baker, male more obtusely angled than female, definitely margined in both sexes. Tubercle of clypeus more distinctly separated from front in male than female, in the later less distinctly so than in **P. tuberculata** Baker. Antennae reaching about two-thirds length of abdomen. Wings longer than abdomen, ovipositor very slightly exserted. Valve of male united with plates or absent. Plates united to tip. Pygofer with a large tooth on ventral margin. Oedagus composed of three very long slender prongs. Last ventral segment of female long, posterior margin almost truncate.

Holotype male, allotype female and numerous male and female paratypes, Chiricahua National Monument, Arizona, August, 1935, R. H. and J. D. Beamer. Swept from Chihuahua pine.

Dorycephalus omani n. sp.

Resembling **Dorycephalus minor** Osb. but smaller, vertex longer, sides converging and tip upturned. Length 6 mm.

Head foliaceous, vertex slightly more than twice as long as wide, sides slightly converging to outer sixth, there narrowing rapidly to sharp tip, outer sixth sharply upturned, median longitudinal ridge large. Pronotum rugose with five more or less definite longitudinal ridges. Elytra longer than abdomen, venation distinct, appendix present. Venter sparsely covered with coarse white pile.

General color cinereous. Vertex with median longitudinal fuscous stripe and a much smaller one on latera!

*Contribution from Department of Entomology, University of Kansas

margin, venter dusky.

Genitalia: Male valve very small, almost hidden, plates broader at base than valve, sharply narrowed on basal third to less than half basal width. Pygofer twice as long as plates, without heavy spines.

Holotype male, Criterion, Oregon, August 2, 1935, R. H. Beamer. 1 paratype, male, same date and place, Mrs. P. W. Oman, in United States National Museum. I take pleasure in naming this interesting insect after Mrs. Oman who has collected a great many rare Homoptera the past few years.

SAMUEL WENDELL WILLISTON

1852 - 1918

Doctor Samuel Wendell Williston, whose photograph appears on the cover of this Journal, came to Kansas with his parents in 1857 and settled in Wabaunsee County. In 1864 he entered the State Agricultural College. Here under the stimulation of Professor Mudge he became a student of paleontology. Independently, he studied anatomy and learned medicine under the family physician.

On one of his fossil hunting expeditions he became interested in collecting insects as a side line and in 1878 deliberately selected the Diptera for his avocational activities. After graduating from the Kansas State Agricultural College (B. S. '72, M. S. '75), he studied medicine at Yale receiving the M. D. in 1880 and the Ph. D. in 1885. After occupying the position of professor of anatomy at Yale University, he came to the University of Kansas as professor of geology and anatomy and as dean of the School of Medicine, a position he held from 1890 to 1902 and where much of his best scientific work was done. He left the University of Kansas entomological collections richly endowed with Diptera types, a testimonial to his industry and interest in entomology as a hobby. From 1902 to his death he occupied the chair of Vertebrate Paleontology in the University of Chicago. Although he never held a position in entomology, his numerous contributions to the subject culminated by his well known **Manuel of North American Diptera** make Kansas entomologists proud to claim him as their own.

H. B. HUNGERFORD.

THE STRATIOMYIDAE OF COLORADO AND UTAH

MAURICE T. JAMES, Colorado State College.

Introduction

Several years ago the writer made a preliminary draft of the Stratiomyidae of Colorado which has never been published as such. With subsequent collecting and the examination of additional collections, this account has been enlarged, to include, not only additional records from Colorado, but also the related fauna of Utah.

The Stratiomyidae may easily be recognized by characters that may be found in any manual of entomology. The peculiar wing-venation, with the crowding of the veins toward the costal margin, is most characteristic. There is a wide range in general appearance; such flies as **Pachygaster and Nemotelus** depart far from the bee-like **Stratiomys** and **Odontomyia,** the more familiar representatives of the family, whereas such unrelated genera as **Hoplitimyia** and **Hermetia** are wasp-like. **Geosargus viridis** resembles such bees as **Augochlora** and the more slender species of **Osmia.**

Not much variation occurs in the habits of the imagines. They are sluggish until once aroused, but are then strong fliers. They may be taken on flowers, particularly umbellifers, on warm sunshiny days; or, in cloudier or cooler weather, they may be swept from vegetation, especially near streams. The larvae of the Stratiomyinae and Clitellarinae are aquatic; the others live in manure, carrion, nests of rodents, under bark, or, rarely, in vegetation.

The economic importance of this family is not great. The aquatic larvae play a part in the economy of nature as an important source of food for fishes. Many terrestrial larvae are scavengers. **Hermetia illucens** Linn., commonly found in garbage, has been recorded as causing intestinal myiasis in man. **Ptecticus trivittatus** Say shows the potentiality of becoming an economic pest, as it has been bred from gladiola bulbs by Mr. F. S. Blanton. Perhaps other of the Sarginae are potential pests. Certain terrestrial larvae are reported to be predaceous.

No claim to completeness is made in this account. Careful and intensive collecting has been done, but it is quite possible that even genera may be added to the fauna of this region. In the keys, genera and species that are most apt to be found in the territory covered in

this paper are included, though all but those actually recorded are omitted in the discussion.

I am indebted to my former colleagues at the University of Colorado, to the American Museum of Natural History, the Utah State College, and Brigham Young University, for the loan of material. The data of this paper are based on these collections, together with my own, that of the Colorado State College, and several minor sources.

The following key, adapted from Hardy (1932) will serve to separate the subfamilies, all of which are found in our fauna.

1. Flagellum of antennae consisting of seven or eight segments, the apical one very long, about equal in length to the remainder of the flagellum, and elbowed ..... HERMETIINAE
   Flagellum of antennae otherwise formed 2

2. Abdomen with seven clearly defined segments, none of which are retracted ..... BERIDINAE
   Abdomen with not more than five clearly defined segments, the others being modified to form part of the tubular ovipositor which is retracted, and similarly reduced in the male 3

3. Antennae normal, at most terminating in a thickened style, never with an arista 4
   Antennae with a hair-like arista 5

4. Cross-vein r-m present ..... STRATIOMYINAE
   Cross-vein r-m absent, the veins R3 and M1 being anastomosed apically ..... CLITELLARINAE

5. Media three-branched (our species yellow or metallic blue or green) ..... GEOSARGINAE
   Media two-branched; (our species small, black flies) ..... PACHYGASTRINAE

SUBFAMILY BERIDINAE

BERIS Latreille

B. annulifera Bigot

Glendevey, Colo., Aug., 1931. Also recorded from Colorado by Banks and Coquillett.

B. mexicana Bell. has been recorded from Colorado, with a query, by Williston. **Actina** and **Allognosta,** common in the east, will probably not be found in our fauna.

SUBFAMILY HERMETIINAE

HERMETIA Latreille

H. chrysopila Loew

Boulder, Colo., May 26, 1934 (D. F. Aultz).

Several other species occur in Arizona, and may extend into southern Utah.

SUBFAMILY STRATIOMYINAE

Key to genera

1. Third antennal segment without a style; the basal segment at least twice, usually three or more times, the length of the second 2
   Third antennal segment with a distinct, though sometimes small, style; the basal segment not more than one and one-half times the length of the second 4

2. Head broader than the thorax; the first antennal segment clavate; the third strap-like ..... **HOPLITIMYIA**
   Head no broader than the thorax; first and third antennal segments cylindrical 3

3. Face produced below the antennae; vein M3 weak; scutellum hemispherical; spines weak, approximate ..... **LABOSTIGMINA**
   Face receding below antennae; vein M3 well-developed to the wing-margin; spines strong, situated at the outer angles of the trapezoidal scutellum ..... **STRATIOMYS**

4. Face produced conically downward **MYXOSARGUS**
   Face not strongly produced downward 5

5. Scutellum unspined 6
   Scutellum spined ..... **ODONTOMYIA**

6. Vein R4 present; medium-sized species, 10 mm. or more in length ..... **ODONTOMYIA** (in part)
   Vein R4 absent; small species, less than 5 mm. in length ..... **CAMPTOPELTA**.

HOPLITIMYIA James

Hoplitimyia vespoides James

Type, "Colo." This is a subtropical and tropical genus; it has been recorded as far north as Kansas.

LABOSTIGMINA Enderlein

Labostigmina similis Johnson

COLO. Cameron Pass, July 3 and 5, 1931 (C. R. Jones).

STRATIOMYS Geoffroy

Key to species*

1. Eyes hairy 2
   Eyes bare 4
2. Fourth segment with oblique yellow markings ..... **maculosa** Loew
   Fourth segment without oblique yellow markings 3
3. Fourth segment with a posterior yellow margin and a median yellow line ..... **badia** Walker
   Fourth segment not so marked .... **occidentalis** Banks
4. Metapleura with black or brown pile predominating 5
   Metapleura wholly pale-pilose 11
5. Mesopleura almost wholly black-haired 6
   Mesopleura wholly pale-haired 7
6. Face mostly yellow, yellow-pilose except above; a tuft of yellow hair above the front coxae ..... **melanostoma** Loew
   Face broadly yellow along the orbits, almost wholly black-pilose; no turf of pale hair above the front coxae ..... **barbata** Loew
7. Propleura in part black-haired ..... **barbata** Loew
   Propleura wholly pale-haired 8
8. Abdomen mainly yellow; pile of head unusually long and dense ..... **hirsutissima** James
   Abdomen black, with yellow markings; pile of head and thorax of normal length and density 9
9. Males ..... **lativentris** Loew
   Females 10
10. Femora reddish ..... **lativentris** Loew
    Femora black ..... **melanostoma** Loew
11. Fourth abdominal segment with at most short prolongations of the pale color inward 12
    Fourth abdominal segment with transverse posterior markings laterally, sometimes with the posterior border yellow 14
12. First two ventral segments wholly yellow ..... **d. media** James
    First two ventral segments marked with black 13

*Modified from Curran (1927)

(To be Concluded in Vol. 9 No. 2, April, 1936)

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